

# Functions of Independent Variables in Research and Program Planning

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**T**HE SIGNIFICANCE of the differences among the relationships of demographic, ideological, and behavioral variables as independent variables to the dependent variable or variables under study is not often considered. Social researchers, when designing and reporting studies related to programs or when consulting with workers on research programs they are interested in undertaking, often consider independent variables in the research as a single group without making important distinctions in the types of independent variables.

Independent variables can be grouped into three broad categories, each of which has a definite usefulness when considered in an applied context. In designing research a first step after statement of objectives and hypotheses should be the identification, as explicitly as possible, of demographic variables (such as age, sex, and race) and those considered as ideological (elements of culture), and behavioral (such as obtaining medical and dental treatment). Although these distinctions are rather obvious, they are all too often overlooked or ignored by researchers and program administrators alike. Hyman (1), Rogers (2), and Rosenstock (3) noted that these distinctions are important.

The place and function of each independent variable in terms of its contributions to the solution of a particular problem should be con-

sidered. Once this distinction is made, the researcher and program administrator will then be in a position to determine if the number of demographic characteristics are adequate and whether the ideological and behavioral variables are appropriate to the project and amenable to change.

Identification of relevant variables could be immensely enhanced, of course, through review of relevant literature. After stating the objective and clarifying the variables considered, the researcher could then consider questions of measurement, sampling, data collection, and analysis.

Differences in independent variables and their importance should be noted early in designing the research, particularly when the dependent variable is an element of the objectives in planning a program. The researcher can then decide which independent variables will do which tasks.

One dimension along which independent variables might be placed or categorized could be called degree of changeability or manipulability. This dimension is extremely important to an administrator responsible for determining those elements in the situation which can be changed and then designing programs that will bring about these changes.

## Demographic Variables

Demographic variables have considerable value in program research or in applied research. They include age, nativity, sex, race,

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family size, income, education, and occupation. Demographic characteristics are computed for various units of analyses—individual persons, families, communities, and regions.

Relationships of demographic characteristics to dependent variables are important, not only in helping to account for variability in the dependent variable, but also in helping a health worker to identify those categories of the population in greatest need of his services. By using demographic information from the U.S. Census or other sources which are compiled by geographic areas, an administrator is in a better position to pinpoint those geographic areas under his jurisdiction that are likely to have the greatest need. Caution is obviously needed in making such an interpretation, but guidelines will be made available. Some demographic characteristics vary considerably in a community; not all parts of a State, county, city, or township will have the same level of income, education, age, or family size.

Observations from various studies can be used to illustrate this point. For example, if research results indicated that "children were less likely to receive attention [following referral from a school health program] if they were members of large families . . .," (4) an administrator interested in increasing referral followups could use census data to identify areas likely to have large families and strengthen programs in these areas. Or in a commonly encountered situation, if the practice of some recommended health behavior, such as annual physical examinations, is observed to be lower among low income groups, reference to census data will enable the administrator to pinpoint those communities or neighborhoods.

Hyman (1) stated that Lazarsfeld has pointed out that even if independent or causal variables cannot be changed, they can be adjusted to. He elaborated by noting that Suchman (5, 6) indicated "the more parochial an ethnic group's structure, the less 'scientific' the group members' attitudes and behavior in the health area." He commented further that although ethnicity cannot be changed, it might be useful for the health administrator to identify and use any existing ethnic clubs, see that some of the members of the project staff are of this ethnic background, and attempt to develop a

physical facility where members of the ethnic group can receive health services at the same location. These are principles that appear to be used currently in organizing many innercity programs (7).

A study reported by Lerner and Kirchner can be used as another example of relating demographic data to a behavioral variable (8). In their research, they related characteristics of age, sex, race, ethnic group, place of birth, annual family income, employment status, and marital status to use of free clinic services in municipal hospitals. In a summary of their observations they noted that users of free services were primarily adults, women of Negro or Puerto Rican background, under 45 years of age, and born chiefly in New York City or elsewhere in the United States. Such data can be useful to administrators of municipal hospitals in their planning. Again, however, it needs to be pointed out that these variables cannot be changed.

In earlier research I related demographic characteristics of communities to voting behavior regarding a referendum to establish a county health department (9). The percentage of affirmative votes for a county health department was related to population growth, population mobility, income levels, and educational levels. These observations can and have been used to identify those municipalities with populations likely to vote for establishing a county health department, those municipalities with populations likely to vote against establishing them, and those where the outcomes could not be predicted.

Although demographic variables are valuable in explaining variations in dependent variables and in helping the administrator locate and work with subpopulations, they nevertheless cannot be altered or controlled through program activities. They, therefore, do not contribute to a more active and direct solution of the difficulty. Helpful as demographic variables may be in identifying high-risk populations, variables such as age, sex, nativity, and race cannot be changed by education or other mechanisms. Even though not biologically determined, income, education, family size, and occupation are also normally thought of as "givens" within which a more specialized pro-

gram must be administered. They are subject to change but usually only after a long period of time or by comprehensive action programs which include employment, education, housing, nutrition, and all other facets of everyday living.

### **Ideological and Behavioral Variables**

Distinct from demographic variables, which I maintain are unalterable, are categories of variables which for brevity I label ideological and behavioral. These can be altered, although not always easily. Ideological variables as I conceive of them in this paper are elements of the culture of a person which, although not behaviors in themselves, have a clear effect on behavior. Ideological variables can be further divided into the cognitive and affective (10). Cognitive variables involve knowledge or belief and are rather neutral in meaning. Affective components of ideology, however, are emotionally charged because they include the element of feeling or affectivity.

In health programs, for example a poliomyelitis immunization program, cognitive elements would include knowledge or beliefs relating to the manner in which the vaccine prevents poliomyelitis, where the information about the program was obtained, and where the immunization could be received. Rosenstock discussed two variables which he asserts are important, both of which are cognitive in nature (3). These are perceived seriousness or severity and perceived susceptibility. Affective components would include the fear, anxiety, emotionalism, or skepticism surrounding the procedure of immunization or real or imagined biological aftereffects. Such ideological variables definitely have an effect on behavior.

Behavioral variables are usually considered as dependent rather than as independent variables. Obtaining topical fluoride treatments for the teeth of children, semiannual visits to dentists, and procuring immunization against poliomyelitis are all behaviors which are usually program goals and serve as dependent variables in research associated with these programs. With far less frequency is one behavior considered as an alternative means to achieve change in some other behavior. It is conceivable, however, that a particular behavior  $B_1$  might be related to

another,  $B_2$ , and, if this is so, then when  $B_2$  is the object of change, work on  $B_1$  may cause some change in  $B_2$ .

The role diet and exercise play in preventing heart disease is an example. It is fairly well accepted that the heart is adversely affected by obesity. Therefore, if weight is controlled by diet and exercise, the risk of heart disease is reduced. Thus, if eating behavior and patterns of exercise can be ascertained and levels measured, specific programs can be initiated to change these behaviors as a means of reducing heart disease. Brushing the teeth is a behavior important in maintaining good dental health.

### **Relationships Among Different Variables**

Research on demographic characteristics of areas with high and low rates of the dependent or program variables of interest would provide knowledge of characteristics of participants and nonparticipants in a program. That is, are younger or older persons, men or women, more likely to participate in a diabetes screening, or would some other program be more acceptable? Research on the relationship of ideological and behavioral characteristics to the dependent variable would provide information on correlated factors which might be changed so as to increase immunization rates or achieve some other program objective. That is, are mothers who have a greater knowledge about how measles vaccine works more likely to have their children immunized than are those who do not have such knowledge?

Going one step further, demographic variables could be related to ideological and behavioral variables so that, in addition to knowing where certain types of users and nonusers are located, the demographic characteristics associated with certain attitudes, knowledge, beliefs, and behaviors would also be known. Once variations in these factors are specified in relation to demographic variables and identified according to geographic area, the program administrator is in a position to direct his efforts to those areas where need is greatest. He can locate high-risk populations geographically through analysis of demographic characteristics and use of census data, and he can effectuate programs based on the ideological and behavioral factors identified as important in this group.

To illustrate this last point more concretely, we might consider a screening program for cervical cancer. The relationship of demographic variables to participation in the screening program would tell us the demographic characteristics of those who participate and those who do not (if differences by demographic characteristics are noted). Then, using census data, we could plot those areas having the demographic characteristics associated with high and low participation. In addition, if questions tapping the cognitive and affective dimensions associated with participation were included in the research and responses were to be related to demographic variables and rates of participation, the administrator is in a much better position to know where (low income areas or areas with a median age of 20-24 years) to concentrate change efforts and in what way (through changes in beliefs, fears, and anxieties).

### Summary

Health programs that use social and related data obtained through surveys or other methods need to distinguish among so-called independent variables. Three groups of independent variables are (a) demographic (age, nativity, sex, race, family size, income, education, and occupation), (b) ideological elements relating to culture and further subdivided into cognitive (knowledge) and affective (emotion), and (c) behavioral variables (patterns of exercise, brushing of teeth, and other health habits).

Demographic variables could be related to ideological and behavioral variables so that the administrator would know what demographic characteristics are associated with certain attitudes, knowledge, beliefs, and behaviors. Once variations in these factors are specified in relation to demographic variables and identified according to geographic area or some other criteria, efforts can be directed to areas where need is greatest.

Demographic variables cannot be changed by

education or other mechanisms. Ideological and behavioral characteristics can be changed, but not easily. Research on demographic characteristics of high and low usage areas would provide knowledge of characteristics of participants and nonparticipants in a program. Research on the relationships of ideological and behavioral characteristics to dependent variables would provide information on factors which might be the objects of change so as to increase immunization rates or achieve some other program objective. Behavioral variables are usually, but not always, program goals.

### REFERENCES

- (1) Hyman, M. D.: *Medicine. In The uses of sociology*, edited by P. F. Lazarsfeld, W. H. Sewell, and H. L. Wilensky. Basic Books, Inc., New York, 1967, pp. 119-155.
- (2) Rogers, E. S.: *Public health asks of sociology. Science* 159: 506-508, Feb. 2, 1968.
- (3) Rosenstock, I. M.: *Why people use health services. Milbank Mem Fund Quart* 44: 94-126, July 1966, pt. 2.
- (4) Cauffman, J. G., Peterson, E. L., and Emrick, J. A.: *Medical care of school children. Factors influencing outcome of referral of a school health program. Amer J Public Health* 57: 60-73, January 1967.
- (5) Suchman, E. A.: *Socio-medical variations among ethnic groups. Amer J Sociol* 70: 319-331, November 1964.
- (6) Suchman, E. A.: *Social patterns of illness and medical care. Health Hum Behav* 6: 2-16, spring 1965.
- (7) Kupchik, G. J.: *Environmental health in the ghetto. Amer J Public Health* 59: 220-225, February 1969.
- (8) Lerner, R. C., and Kirchner, C.: *Social and economic characteristics of municipal hospital outpatients. Amer J Public Health* 59: 29-39, January 1969.
- (9) Crawford, C. O.: *Variables related to a referendum vote on creating a county health department. Public Health Rep* 84: 639-646, July 1969.
- (10) Gold, J., and Kolb, W. L.: *A dictionary of the social sciences. Free Press, New York, 1964, p. 13.*



**Nursing Careers in Mental Health.** *PHS Publication No. 1051; revised October 1968; 15 pages; 30 cents.* A 15-page illustrated booklet addressed to young men and women who may be considering nursing careers in mental health and to those who are already in training or practice who may wish to specialize. Discusses such questions as: What is psychiatric-mental health nursing? What are the educational requirements? What financial aid is available through National Institute of Mental Health training programs and from other sources? Describes various training programs, ranging from 2-year programs to postgraduate education.

**Environmental Health Planning Guide.** *PHS Publication No. 823; revised 1968; 99 pages; \$1.* This guide deals primarily with the process of bringing together certain fundamental data pertaining to various physical aspects of the environment. Includes a limited list of environmental aspects which encompass those categories where obvious and direct hazard to health has been widely recognized. Gives emphasis to the evaluation of health-related utilities and services that readily lend themselves to long-range planning such as water, sewerage, solid wastes, air pollution, and housing programs. Covers health department inspectional services in an organizational sense and refers to existing rating schedules for a number of these vital services.

**Electronics for Hospital Patient Care.** *PHS Publication No. 930-D-25; by Noyce L. Griffin; 1968; 66 pages; 70 cents.* Presented in two parts. Part I contains a revision and expansion of publication No. 930-D-12, "Electronic and Related Electrical Equipment in Hospitals, 1963." Part II contains a report of a recent onsite study of current practices of

electronic monitoring of patients, needs of facilities and equipment, and trends in the use of electronics that are expected to stimulate development and improvement of equipment, affect future planning of facilities, and emphasize the need for enlightenment in bioelectronics. Provides an overall picture for those not concerned with technical details. Includes appendixes which offer further particulars, statistics, and illustrations.

**Hospital Electrical Facilities.** *PHS Publication No. 930-D-16; By Noyce L. Griffin; 1969; 36 pages; 50 cents.* Contains guidelines that have been rewritten to reflect changes in current practices, to provide up-to-date references to applicable codes and standards, and to conform with recommended design practices that should be followed in the construction of hospitals and health facilities.

**Regulations, Standards, and Guides Pertaining to Medical and Dental Radiation Protection.** An annotated bibliography. *PHS Publication No. 999-RH-37; by David R. Snavely, Larry G. Kumbier, Mark J. Thompson, and Lloyd R. Setter; 1969; 73 pages.* Annotated bibliography of standards, regulations, and guides pertaining to medical and dental ionizing radiation protection. Includes annotations of general standards, guides, and recommendations; standards on the safe operation, handling, and design of radiation equipment and sources; and standards and guides pertaining to radiation measurement. Annotated documents are designated as class A (established or adopted by a governmental body acting under the authority of an act, law, or statute), class B (adopted by consensus of committees or commissions of technical competence in standards-setting organizations), or

class C (not adopted by a standards-setting organization, but contains information pertinent to the preparation of suitable standards or regulations). Annotations include identification of the document, type of standard, intended complier, intended benefiter, limits and specifications, and general guidance.

**Special Report: First United States Mission on Mental Health to the U.S.S.R.** *PHS Publication No. 1893; 1969; \$3.50.* Reports the observations of the delegation and compares and contrasts the organization and delivery of mental health services in Russia with the provision of mental health care in the United States. Concentrates on the organization, structure, and delivery of mental health services in the U.S.S.R. but includes as well some observations on Soviet mental health research and therapy. A major portion concerns the interface between Russian psychiatry and the law. Also contains many photographs of Russian psychiatric personnel and facilities.

**1969 Directory of Migrant Health Projects Assisted by Public Health Service Grants.** *Revised March 1969; 178 pages.* Lists grant-assisted public and private nonprofit agencies which provide health services for migrant farmworkers and their families. Identifies location, project director, number of migrants eligible, and services provided by each project. Lists State contact persons for migrant health.

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This section carries announcements of new publications prepared by the Public Health Service and of selected publications prepared with Federal support.

Unless otherwise indicated, publications for which prices are quoted are for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Orders should be accompanied by cash, check, or money order and should fully identify the publication. Public Health Service publications which do not carry price quotations, as well as single sample copies of those for which prices are shown, can be obtained without charge from the Public Inquiries Branch, Public Health Service, Washington, D.C. 20201.

The Public Health Service does not supply publications other than its own.

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**COLOMBOTOS, JOHN** (Columbia University School of Public Health and Administrative Medicine): *Personal versus telephone interviews: Effect on responses. Public Health Reports, Vol. 84, September 1969, pp. 773-782.*

Telephone interviews have practical and administrative advantages over face-to-face interviews, particularly if the respondents are scattered over a wide area. But it has been argued that lengthy telephone interviews in which the respondent is asked about complex topics are not

feasible and that responses in attitude surveys conducted by telephone, even if they are obtained, are not as "valid" as those collected in face-to-face interviews.

Previous research has indicated that personal interviews are more likely to elicit socially acceptable re-

sponses than self-administered questionnaires because of the "social component of involvement" between interviewer and respondent. The telephone interview falls between the personal interview and the self-administered questionnaire in the opportunity for such involvement.

Data from two surveys of physicians show that there are essentially no differences in the proportions who give socially acceptable responses according to whether they are interviewed in person or by telephone.

**GLICK, CHARLES A.** (Department of the Army), and **WEDUM, ARNOLD G.:** *Leak tests by high-velocity impact of infectious specimen containers. Public Health Reports, Vol. 84, September 1969, pp. 783-786.*

Thirty replicates of three types of packages commonly used for transmittal of infectious diagnostic fluid specimens in test tubes by postal mail were impacted on concrete at average velocities of 130 to 133 feet per second (89 to 90 miles per hour). This impact velocity is representative of the calculated and experimentally determined net impact on a

container during a crash takeoff or landing of aircraft. The test impact velocity, however, was attained in 6 feet by sudden acceleration, and the actual total effect on the test packages was greater than that caused by terminal impact at 130 feet per second.

Although most of the inner test tubes broke and a spot of dye showed

through the outer container of one package, there was no leakage of contents through the outermost mailing tube. These mailing tubes met the packaging requirements for domestic mail and, although they did not comply completely with U.S. Postal Manual section 221.325 c.(2) for international mail, they easily met the intent of that regulation, which is to insure no leakage under conditions ordinarily incident to handling during transportation.

**SIKES, R. KEITH** (National Communicable Disease Center, Public Health Service): *Human rabies immune globulin. Progress report. Public Health Reports, Vol. 84, September 1969, pp. 797-801.*

A total of 2,500 ml. of rabies immune globulin of human origin (HRIG) has been produced by the Rabies Unit of the National Communicable Disease Center, Public Health Service, and is now being tested in human beings. This globulin

has passed all safety tests, and it contains 165 international units per ml., which is equal to the potency of antirabies serum of equine origin (ARS) now prescribed in the United States for persons exposed to rabid animals.

Human rabies immune globulin gave animals challenged with rabies virus as much protection as ARS. The next step is to develop for human use a satisfactory regimen of HRIG in conjunction with rabies vaccine. Being a homologous globulin, this HRIG should preclude serum sickness in exposed persons who are sensitive to equine serum.

**ALEXANDER, RAYMOND S. (New York City Health Department) and PODAIR, SIMON: *Educating New York City residents to benefits of Medicaid. Public Health Reports, Vol. 84, September 1969, pp. 767-772.***

On June 6, 1967, officials of New York City's departments of health and social services started a campaign to enroll all persons eligible for Medicaid. Of the more than 3 million persons who were eligible under the original New York State Medicaid law, 2 million had not enrolled.

Keeping eligible persons from enrolling were a general lack of knowledge of Medicaid and its benefits, confusing the program with Medicare, and a belief that one had to be on relief to be eligible.

Target groups for the campaign were families whose income was above the public assistance level and the aged who could obtain additional services not covered by Medicare, such as prescription drugs, dentistry, extensive podiatry, and optical services.

To overcome apathy and arouse public interest, health educators in

30 health districts were mobilized by the bureau of public health education to obtain community support. Many types of volunteers were used—professional leaders, active lay leaders, informal leaders (such as active block workers), volunteers from the police auxiliary, and persons from antipoverty programs.

Techniques used to inform the public about Medicaid were (a) Neighborhood Medicaid Days—sound trucks at busy locations manned by district health educators and volunteers, who answered questions of passers-by, (b) Medicaid Shoppers Days—an information table placed in three department stores in Brooklyn to reach shoppers who might be eligible for Medicaid, and (c) literature distributed in the streets and through department stores, banks, post offices, supermarkets, and schools.

Newspaper, radio, and television publicity, although previously difficult to obtain, were part of the campaign, and health department officials made personal appearances on TV. Car cards were placed in the city subway systems, and posters were distributed at hospital outpatient clinics, health centers, and antipoverty offices for posting.

Approximately 450,000 persons applied for Medicaid during and immediately following the campaign. Among other benefits realized from the efforts was the demonstration that two large public agencies in a metropolis could work together to heighten public interest in health care.

The public was introduced to the components of wide spectrum health care—preventive medicine, the importance and significance of choosing a source of health care before illness, the significance of early and proper treatment of disease, and the contributions of dentists, podiatrists, optometrists, and other members of the health team.

**JACKSON, CHARLES L. (Oklahoma State Department of Health): *State laws on compulsory immunization in the United States. A review. Public Health Reports, Vol. 84, September 1969, pp. 787-795.***

A review of State compulsory immunization laws revealed that 26 States and the District of Columbia now have legislation requiring immunization against a disease or diseases as a prerequisite to school entry. The legal base for such laws is the U.S. Supreme Court ruling of 1905 that upheld the constitutionality of the Massachusetts compul-

sory law on smallpox vaccination. Although initial State legislation on compulsory immunization pertained to smallpox only, by the late 1930's compulsory laws including other diseases were enacted.

Analysis of the structure of State laws on compulsory immunization revealed that most State laws of this type now require compliance from

the parents of children in public, private, or parochial schools. Almost all diseases that can be prevented by immunization are included. The children of parents who object because of medical or religious reasons are exempted. The penalty for non-compliance is considered a misdemeanor and usually is not enforced.

The value of State compulsory immunization laws continues to be controversial. Arguments for and against such legislation are analyzed.



**GORWITZ, KURT (Maryland Department of Mental Hygiene): *Survey of State-level programs in mental health statistics. Public Health Reports, Vol. 84, September 1969, pp. 803-811.***

Of the 48 State directors of mental health statistics responding in a 1968 survey, 23 had only a bachelor's degree, 17 had also received a master's, and five had attained the doctorate. Three had not graduated from college. These figures were essentially unchanged from comparable survey results in 1965. The average length of continuous employment in mental health statistics was 5.5 years, a slight reduction from a 1965 survey result.

The median salary of the directors was \$11,333, or \$3,483 higher than the median obtained from a survey

conducted in September 1963. The 1968 median salary was equal to a compound annual increase of 8 percent. Salaries were related to the highest degree attained. The range was from \$6,875 for three directors with no college degree to \$18,750 for five directors with a doctorate.

State mental hospital statistics programs had an average of 4.4 clerical employees and 1.4 professional employees—a slight increase in both categories since 1965. The directors indicated a need for an additional 174 professional employees and 164 clerical employees in the

next 5 years. Should this additional personnel materialize, the currently authorized professional staffs would be doubled and the clerical forces increased by 50 percent.

A majority of the directors indicated that they or their staffs had neither presented papers at professional meetings nor published any papers in professional journals during the preceding 3 years. Comparable figures had been noted in 1965.

The average budget for statistics was \$33,888. The total expenditures for these programs in all States was estimated to be between \$4 million and \$4½ million, or approximately 0.25-0.30 percent of the total cost of operations.

**CRAWFORD, CHARLES O. (Pennsylvania Department of Health): *Functions of independent variables in research and program planning. Public Health Reports, Vol. 84, September 1969, pp. 831-834.***

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